CORE LIST

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A Jarring Subject

In the great impatient American tradition, we have rushed out to beat inflation with a spade, a garden hoe, and a jar lid.

We have produced some prize-winning blisters, aches, and pains. We've reached the depths of despair with elusive canning lids, stubborn unjelling jelly, petulant pickles that wouldn't pucker-up, and acid tomatoes that developed mold.

Based on the sale on home garden type seeds, it is estimated that there have been an additional 6 million new gardeners in each of the past 2 years. Between 25 and 50 percent of these people practice some form of home food preservation. An estimated 4 billion jar lids will be manufactured for use in this country in 1976.

Home canning can provide safe, inexpensive, quality products. This is true only if the fruits and vegetables to be canned have been carefully selected and properly processed.

Home canners should not take shortcuts or be otherwise creative when canning. Only tested, currently approved methods should be used.

Using poor quality fruits and vegetables or experimental canning techniques can result in botulism—a food poisoning which killed two people last year. According to the Center for Communicable Diseases in Atlanta, Ga., of 14 botulism outbreaks in 1975, 10 involved improper home processing, 2 were commercially processed, and 2 were untraceable.

Organisms that cause food spoilage—molds, yeasts, and bacteria—are always present in the air, water, and soil. Enzymes that may cause undesirable changes in flavor, color, and texture are present in raw fruits and vegetables.

When fruits and vegetables are canned, they must be heated hot enough and long enough to destroy the spoilage organisms and stop the action of enzymes.

Recent ARS research, reported on page 12, has found how the microorganism causing botulism can occur even in high acid home canned foods. Still more research is needed in the home canning area.

As more knowledge becomes available, ARS scientists will share it with consumers.—*M.M.M.*

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COVER: "Sugar House" of the Rio Grande Valley Sugar Growers, Inc. where implementation of research led to successful production tests in making crystalline sugar from juice extracted from sweet sorghum (0475X363–1). Article begins on page 3.

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Earl L. Butz, Secretary
U.S. Department of Agriculture

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Agricultural Research Service

A "sugar house" technician collects sweet sorghum juice for laboratory testing (0475X361–29).

Sugar from Sorghum

Another Step Forward

SUCCESSFUL FACTORY processing tests indicate that sweet sorghum may be on its way to joining sugarcane and sugarbeets as an additional source of crystalline sugar.

Chemists Bruce J. Lime and B. Ashby Smith of the Food Crops Utilization Laboratory (P.O. Box 388, Weslaco, TX 78596) conducted the processing tests at facilities of the Rio Grande Valley Sugargrowers, Inc.

The mammoth effort, enlisting the talents of ARS scientists in Meridian, Miss., as well as Weslaco, and of Texas Agricultural Experiment Station researchers and the Rio Grande Valley Sugargrowers, Inc., Santa Rosa, Tex., resulted in the factory production of 22 tons of raw sugar from sweet sorghum.

Standard cane harvesting and processing equipment was used to produce the sugar, which has a purity equal to cane sugar. New sweet sorghum varieties, improved growing, harvesting, and processing techniques, and innovative research led to the successful factory production tests.

The production tests show that sweet sorghum can be milled in conventional sugarcane mills and that the raw juices

Above: *At present, standard sugarcane harvesters are used to harvest sweet sorghum. Unlike sugarcane, which is smooth, sweet sorghum has leaves on its stalk which are thrown into the waiting trucks along with the stalk portion. This complicates the cleaning of the stalk for processing. Texas A. & M. University engineers at Weslaco are modifying the harvesters to remove the unwanted leaf matter, helping make sorghum production for sugar practical (0475X362–10).* **Lower left:** *Freed of their raw juices by squeezing, sorghum stalks tumble from a mill at the "sugarhouse." Observing are (left) plant general manager Jack Nelson, and members of his engineering staff (0475X362–20).*

can be freed of objectionable starch by standard cane juice clarifiers. The presence of starch in sirup can prevent sugar crystals from forming. The Weslaco-based scientists found a way to remove the starch before it goes into solution. Sweet sorghum could be used only for the manufacture of sirup before this breakthrough was achieved.

The starch removal procedure requires eight steps: (1) Stalk preparation; (2) extraction of raw sugar-bearing juice; (3) clarification and removal of starch from juice; (4) evaporation of clarified juice to semisirup; (5) removal of additional starch from semisirup; (6) concentration of semisirup to heavy sirup; (7) removal of the impurity, aconitic acid, from heavy sirup; and (8) crystallization of raw sugar from heavy sirup by conventional sugar procedures.

A variety selection program at the ARS Sugar Crops Field Station at Meridian, Miss., culminated in the release of three high sucrose sweet sorghum varieties. Of the three, Rio is early maturing and adapted to a wide geographical area in the southern United States. Roma and Ramada are more specifically adapted to the Lower Rio Grande Valley of Texas. The development of the new sweet sorghum varieties made sugar production feasible because three varieties provide greater protection from loss by disease than does a single variety.

Sugar production from sweet sorghum offers great promise in extending the production season of the sugarcane industry by 2 to 3 months. A fuller utilization of labor and equipment for a longer period may also reduce the cost of crystalline sugar to consumers.

Commercial production of sugar from sweet sorghum could help the United States become much less dependent on foreign sources for 30 percent of the estimated 11.5 million tons of sugar consumed here annually.—*E. L.*

Now: Soy yogurt

FOOD-MAKING BACTERIA that break down sugars man cannot digest have been used to make yogurt from a new soy milk in ARS studies.

Both the new milk and the yogurt have flavors more acceptable than that of traditional soy milk. Also, there is more available protein in the new milk, giving the yogurt a desirable, firm curd.

The fermentation studies at the Northern Regional Research Center, (1815 North University, Peoria, IL 61604) were conducted by Hiroshi Kanda, visiting Japanese industrial scientist, and chemist Hwa L. Wang, microbiologist Clifford W. Hesseltine, and home economist Kathleen A. Warner, all of ARS.

In an earlier study, Dr. Wang, Dr. Hesseltine, and others found that ARS Culture Collection strain B–1910 of *Lactobacillus acidophilus* thrives on the soybean sugars, raffinose, and stachyose. Unless predigested, these sugars ferment in the lower gut of humans and produce gas.

For the yogurt studies, the Northern Center team used B–1910 with *L. acidophilus strain* B–2092. B–2092 uses beet and cane sugar and imparts good flavor to fermented soy milk. Both B–1910 and B–2092 convert the sugars to lactic acid, a characteristic component of sauerkraut, sour milk, pickles, and other fermented foods.

In making the new soy milk, the Northern Center team applied some of the latest scientific theory as well as some of the strongest opinion evolving from centuries of Oriental soy food fermentations. Scientists postulate, for example, that inactivating an enzyme, lipoxygenase, with heat or acidic conditions prevents off flavors from developing in soy food products. In some parts of the Orient, natives maintain that soaking soybeans in baking soda solutions reduces the beany flavor.

"We incorporated both treatments in our process," says Dr. Wang. After a 16-hour soaking, soybeans were boiled 5 minutes in 0.2 percent sodium bicarbonate solution.

Since heating reduces protein solubility, the scientists subjected the boiled, slurried beans to sound energy above the frequency of human hearing. Ultrasonication was announced last year by chemist Li Chuan Wang of the Northern Center as a way of solubilizing protein in soy products.

Protein content of the milk affects acidity and flavor as well as texture of the yogurt. Acceptable yogurt can be made from soy milk containing 3.6 to 4.5 percent of protein.

If flavored yogurt is desired, vanilla, orange, strawberry, or lemon can be added to the new soy milk before it is inoculated with the fermenting culture.—*D. H. M.*

Refeeding wastes to beef cattle

THE TYPE of ration initially fed determines the value of beef cattle wastes for refeeding to cattle.

Feces and manure from housed cattle on a low-roughage ration generally met the nutritional requirements for refeeding as a high-energy ration, in cooperative studies with the University of Nebraska, Lincoln. Supplemental manganese may be needed.

Wastes from outdoor feedlots contain 45 to 95 percent soil and are not suitable for refeeding, reports ARS microbiologist James R. Ellis (144 Keim Hall, University of Nebraska, Lincoln, NE 68583).

Dr. Ellis says that the practical limitation on refeeding cattle wastes is the large quantity of digestible dry matter and the high handling costs. Rising feed costs and the desire to make maximum use of wastes nevertheless have caused some to consider refeeding.

The study showed that the suitability of excreted materials for refeeding declines as the amount of roughage in the original ration increases. Feces from a high-roughage ration, for example, could be reused only as the roughage component of a ration. They would be equivalent to those from a low-roughage ration if potassium, sodium, and manganese were added.

Dr. Ellis and associates analyzed composition of feces from cattle in metabolism crates on high, medium, and low-roughage rations, feces and manure from cattle on low-roughage rations in a housed feedlot, and wastes from cattle on low-roughage rations in an outdoor feedlot. Roughage level in the ration influenced gross energy, crude fiber, crude protein, nitrogen in all forms, potassium, phosphorus, manganese, and other mineral elements in the wastes.—*W. W. M.*

METABOLIC SLEUTHS

RUN a complex organic compound, unknown in nature, through a living system (plants), where some of it is broken apart and the pieces possibly reassembled in various arrangements. Then run plant material containing original and rearranged compounds through a second living system (animals). Here further breaking apart and putting together may occur before part but not all of the chemical end products are expelled.

Identify the end products, or metabolites, formed in plants and animals, and determine whether they are harmful to the plant, the animal that ate the plant, or man who eats the animal or its products.

This kind of chemical detective work at the Metabolism and Radiation Research Laboratory (P.O. Box 5033, Fargo, ND 5674) gives needed insight into how herbicides used on crops may affect successive living systems in the food chain.

Studies tracing herbicide metabolism through plants and animals in succession simulate the most common way livestock are exposed to herbicide residues—by grazing treated forage or eating the hay. Herbicides for these studies are radiolabeled with carbon-14 to aid in tracing movement through plants and animals and in measuring amounts of metabolites found.

ARS chemist Gerald G. Still, technician Eugene R. Mansager, and chemist Gaylord D. Paulson, in a study with the herbicide chlorpropham, found that all but 1 to 4 percent of the metabolites are eliminated within 72 hours by rats or sheep fed shoots of treated alfalfa. Chlorpropham is used for weed control in alfalfa, soybeans, and other crops.

These studies often involve previously unknown breakdown products and lengthy purification and identification procedures. Twelve metabolite fractions were identified, after four purification steps, in the urine of rats fed treated alfalfa shoots. Fractions making up 12.3 percent of the total were not analyzed.

The researchers treated 55-day-old alfalfa plants with labeled chlorpropham for 7 days. In the shoots, they recovered 62 percent of the radiolabel as unmetabolized chlorpropham, 18 and 9 percent as two major metabolite fractions, and 11 percent as residues that were not further analyzed. Harvested alfalfa shoots or roots were then fed to five rats or a sheep.

At slaughter, 72 hours after feeding treated shoots, 71 percent of the carbon-14 in the rats had been excreted in the urine and 23 percent in the feces. Less than 1 percent was in rat carcasses. In sheep, the proportions were 78 percent in urine, 18 percent in feces, and less than 1 percent in the carcass.

The scientists concluded that monogastric animals, represented by the rats, and ruminants such as sheep metabolize chlorpropham in a similar fashion.

The study also demonstrated differences in metabolism of the same herbicide should an animal accidentally consume the herbicide itself and when it eats forage treated with the same herbicide. If the herbicide is first metabolized by the plant, metabolites that the plant but not the animal can synthesize may be recovered in urine or feces of the animal that ate the treated forage.

Eleven percent of the radiolabel in rat urine was the metabolic isopropyl-2-hydroxy-5-chlorocarbamate in two chemical forms. Rats do not form this metabolite. The amount, however, corresponds closely to the 18 percent of a closely related product found in alfalfa. This metabolite in alfalfa apparently was excreted by the rats in an altered form.—*W. W. M.*

FMD Vaccine — A New Concept

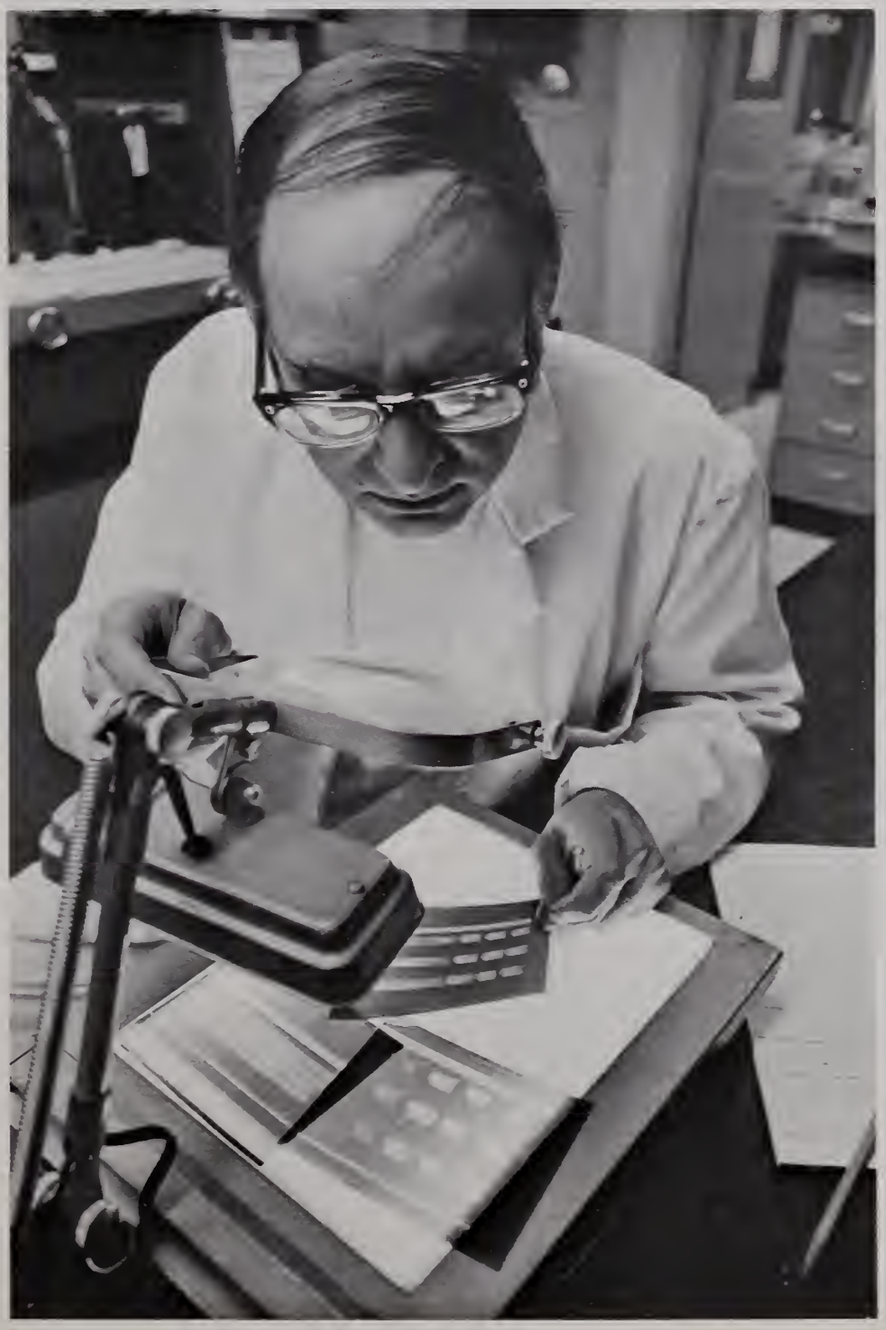
FOR the first time, a new concept in vaccines is being used experimentally to protect livestock against foot-and-mouth disease (FMD)—the most dreaded disease of livestock. FMD is highly contagious and has been responsible for tremendously expensive livestock losses throughout the world.

The team responsible for this milestone in basic research on virus vaccines is headed by chief scientist Howard L. Bachrach of the Plum Island Animal Disease Center (Greenport, Long Island, NY 11944). Other members of the ARS research team include microbiologist Douglas M. Moore, veterinary medical officer Peter D. McKercher, and chemist Jerome Polatnick.

The new, experimental vaccine developed by the Plum Island scientists is made from a protein from the noninfectious coat of the virus. By contrast, the virus vaccines used throughout the world today on both livestock and people are made from whole killed viruses or weakened live viruses. The latest research shows that only the outermost protein from a virus is necessary to arouse an animal's immune response. The new, experimental FMD vaccine utilizes this concept. Thus, no animals vaccinated with the new vaccine will receive whole viruses.

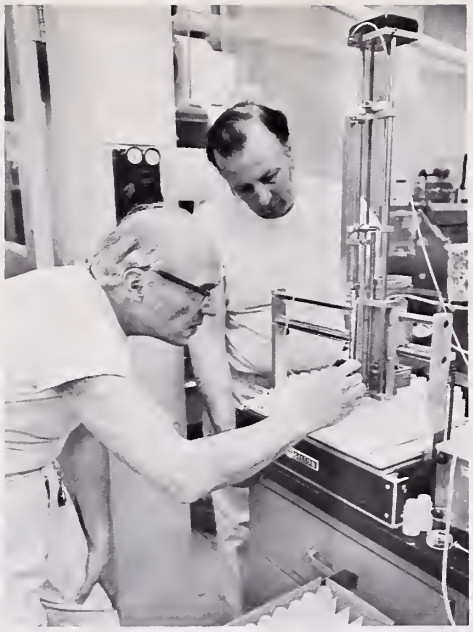
Despite the care in preparing whole-virus vaccines today, there is no absolute assurance that every virus particle is either killed or rendered harmless. Although the new vaccine is still experimental, the tests made thus far have proven it effective in protecting swine against FMD.

There have been no outbreaks of FMD in this country since 1929 because of stringent import restrictions and the constant alertness of U.S. regulatory personnel. However, each year the risk grows greater with increased travel

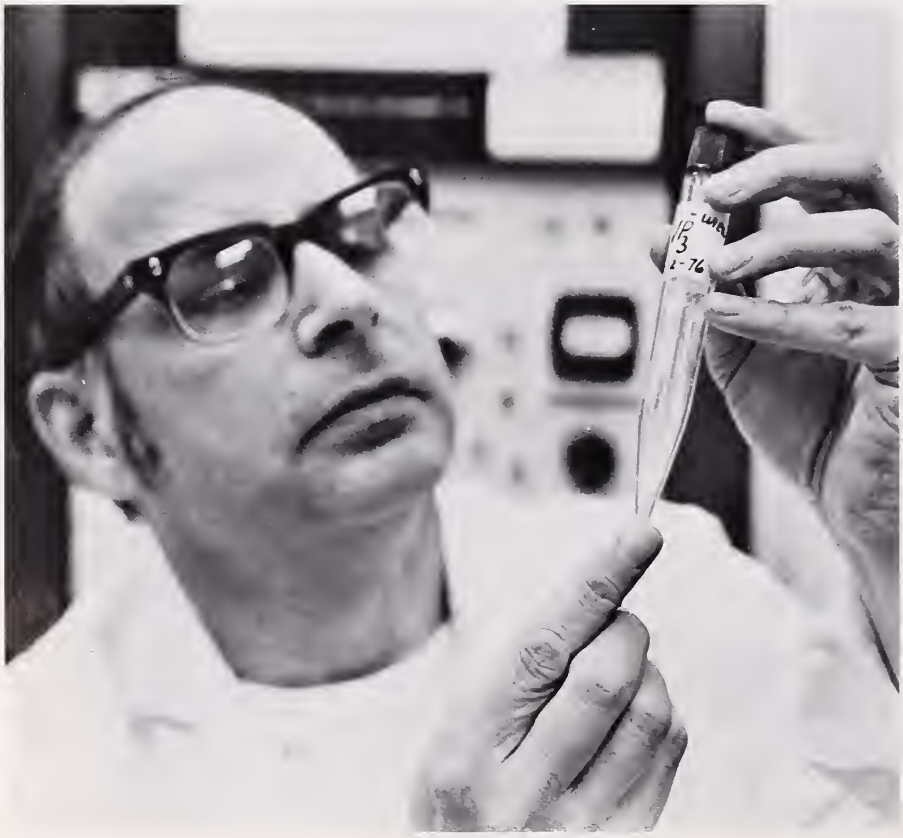


Dr. Bachrach examines photographic images of electrophoretic separation of FMD virus coat proteins (476X338–29A).

FDM vaccine



Above: *In gene "mapping" studies, Dr. Palatnick and technician Robert Goldsmith prepare polyacrylamide gels for slicing in order to locate the radioactively labeled coat proteins of FMD virus. This research will establish the relative location of the genes for each protein along the viral RNA strand (0476X339–20).* **Below:** *Dr. Bachrach examines a vial containing freeze-dried virus protein 3 which will be used to prepare experimental vaccines (0476X337–11A).*



abroad and the prevalence of the disease throughout most of the world.

During 1967–68, England and Wales had over 2,000 outbreaks that resulted in the necessary slaughter of about 400,000 cattle, swine, sheep, and goats. The United States has had nine outbreaks since 1870, costing the Government and the livestock industry well over a quarter of a billion dollars. The longest and most costly single U.S. FMD eradication effort was a joint United States-Mexican campaign from 1947 to 1954. It involved 8,000 Mexican and United States personnel and cost us $136 million.

The only major areas of the world now free of FMD are the North American and Australian Continents along with the smaller geographically isolated areas of New Zealand, Japan, Great Britain, and the Scandinavian countries. The rest of the world lives with a vaccination program *and* the disease.

An important spinoff of the new experimental FMD vaccine is the implica-

A pig is inoculated with virus protein 3 vaccine by laboratory technician William Doraski. The effectiveness of the vaccine will later be assessed by exposing the animal to virulent FMD virus (0476X–336–32A).

Plum Island lies off the eastern end of Long Island, thus providing natural isolation for research with exotic animal diseases. For many years Plum Island was an Army Coast Artillery base, Fort Terry (0476X341–19).

tion it carries for human vaccines. The FMD virus along with polio virus and the common cold viruses, are members of the same group of viruses, known as the picornavirus group—small-sized viruses containing ribonucleic acid (RNA). All picornaviruses have the same basic architecture—an RNA core (the disease-causing portion of the virus), surrounded by a protein coat consisting of 60 copies of each of 4 different proteins.

Polio virus vaccines, like the livestock vaccines, are made from killed whole viruses or modified live (weakened) viruses. Polio vaccines have been highly successful and acceptable. However, they have had some drawbacks that might be eliminated by the use of a protein vaccine.

There are extremely slight risks, for example, that some virus may have escaped being killed or weakened sufficiently. Also the chemicals used to inactivate the infectious RNA core of a killed-virus vaccine can cause side effects, or can sometimes alter the protein responsible for activating the immune responses in such a way that protection is lessened. Since the new experimental FMD vaccine shows that only the outermost protein of the virus coat is necessary to produce the immune response, the hazard of inadvertent infection by virus particles that escaped being killed or weakened is eliminated.

According to Dr. Bachrach, using whole viruses to extract the protein for the new FMD vaccine requires expensive, time-consuming techniques, so the next step forward will be to map out the exact chemical structure of the crucial protein molecule in the FMD virus. Then the new vaccine can be built synthetically in a laboratory without the use of viruses.

As the agricultural researchers have pushed ahead into this new frontier in vaccines, the medical scientists are also at work developing experimental protein-coat vaccines to help combat human virus diseases.—*V. M. D.*

Dr. Moore introduces radioactive iodine into the coat protein of FMD virus for later analysis to determine the specificity of reaction between the labeled protein and antibody molecules (0476X336–11A).

Because the feeding boards are made of wood, a test tube feeding chamber was created to permit photographing a bee in the feeding position—its proboscis extended into the feeding tube. This adult worker is eating a sugar-water solution (0576X487–35A).

Feeding bees—— individually

A successful new feeding device used to feed honey bees individually in the laboratory is an important step forward in bee research.

With this technique scientists will be able to measure and attempt to breed for honey bee resistance to diseases, to solve problems of bee nutrition, and to assess the effect of pesticides when bees pollinate treated crops.

Bee researchers often need to use individually fed worker bees in their experiments, but a good technique has not previously been available. Simple mass feeding is not effective because bees in a group may receive their food from other bees rather than from the feeding container. This disrupts the distribution of the material to be tested. Some bees are not even exposed to it.

More recently, investigators have fed bees with a laborious, time-consuming hand-feeding technique. Each bee is held by the wings and its mouth parts are touched to a droplet of food. The technique is much too slow for experiments requiring large numbers of bees.

Earlier methods to individually feed bees also posed problems. When starved bees are confined in a glass shell vial with food placed in a pipette or as microdroplets in glass cups attached to an enclosing cork, the bees become agitated. They run rapidly around in the vial, often smearing their wings and legs with food.

Geneticist Thomas E. Rinderer of the ARS Bee Breeding and Stock Center Laboratory (Route 3, Box 82–B, Ben Hur Rd., Baton Rouge, LA 70808) has determined three requirements for a feeding system. The feeding chamber must have opaque walls, a walking surface easily grasped by the bees, and food associated with light.

Most stimuli that are irrelevant or detract from feeding are minimized by the first two requirements. The third requirement takes advantage of bees' positive phototaxis—their movement toward a source of light—and leads them to the food.

The technique is reliable and, importantly, it is rapid. "Two people can easily feed 200 to 300 bees an hour," says Dr. Rinderer.

The feeding device consists of 25 feeding chambers made by drilling holes 3 centimeters (cm) deep by 1.2 deep by 1.2 cm in diameter along the length of a 48.4-cm pine board. A tapered cork, fitted with glass tubing through its length, confines a single bee in a feeding chamber. Before confinement, the inside end of the glass tubing is loaded with a droplet of liquid food. These droplets are dispensed from a tuberculin syringe mounted on a microapplicator.

Tests of the feeding device were conducted with adult bees 1, 2, 3, and 4 days of age. Bees of each age category were fed for 10, 20, or 30 minutes. Also, 2-day-old bees were fed for 40 minutes. In all these tests, bees were starved for 1 hour, anesthetized 3 to 4 minutes with carbon dioxide to facilitate handling, and placed in the feeding chambers. When each bee had apparently revived from the carbon dioxide treatment, it was enclosed in the chamber with the food-containing cork. Feeding boards were placed with the corks facing 15-watt daylight fluorescent tubes.

Timing was then begun for the feeding period. When the feeding corks were

removed they were examined with an illuminated hand lens for the presence or absence of the food droplet. Those bees removing only part of the food were classed with those removing none of it.

The system was also tested without bees, to control for the effects of evaporation.

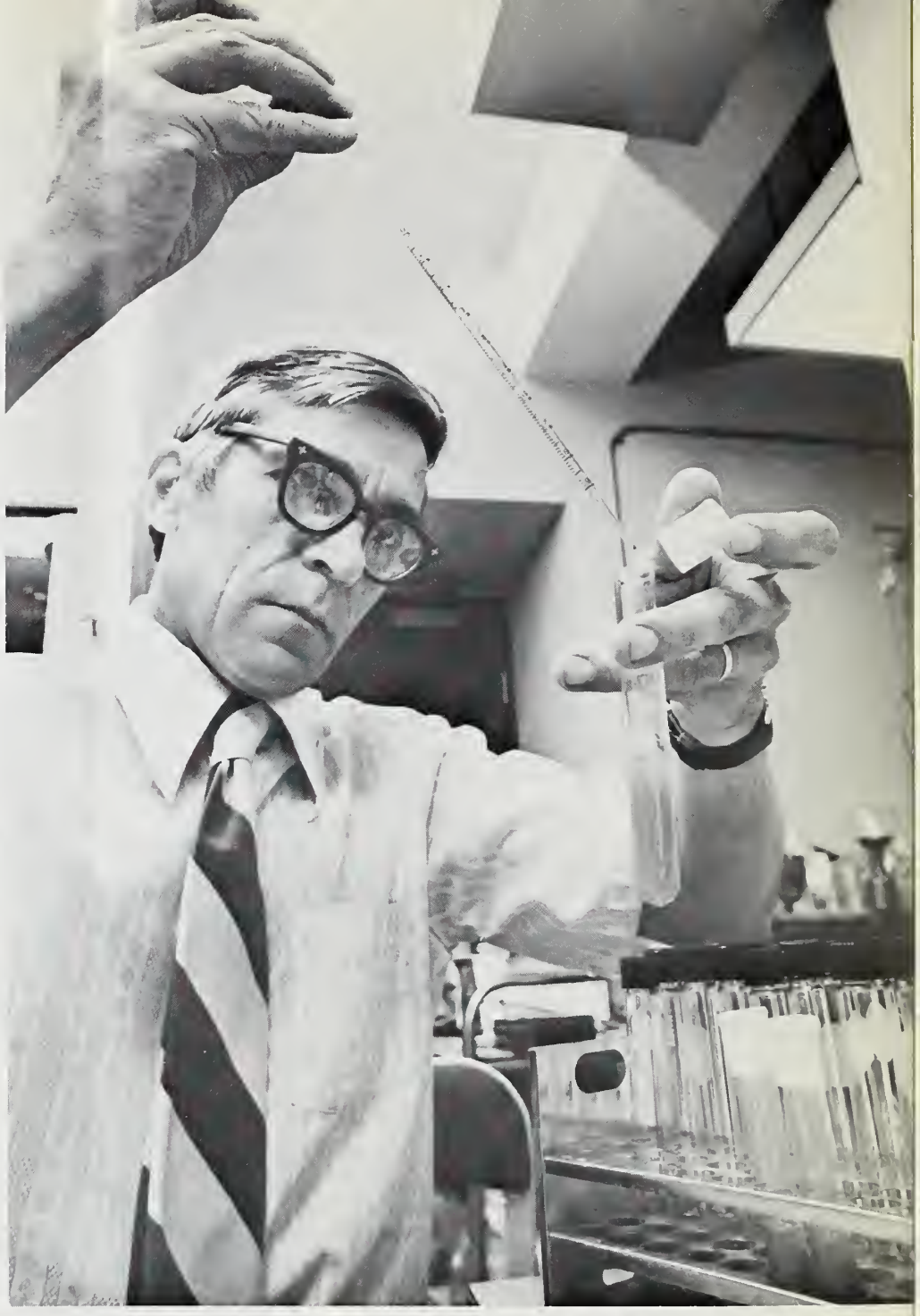
The bees readily consumed the food. While the 10- and 20-minute feeding periods were not long enough to insure a high percentage of food removal, the 30-minute period for 1-, 3-, and 4-day-old bees resulted in 99, 99, and 100 percent food removal, respectively. The 2-day-old bees had a performance of 99 percent removal at the 40-minute feeding period, equal to the performance of the other three age groups at 30 minutes. None of the food removal was attributed to evaporation.

"With longer feeding periods the system becomes reliable," said Dr. Rinderer. "Replicates at the 30- and 40-minute feeding periods of all age groups were quite uniform."—*P. L. G.*

After the feeding boards are loaded with bees and food, they are stacked facing a light source. The light passing through the feeding tube attracts the bees to the food suspension (0576X486–20A).

To insure a constant volume droplet—five microliters—a microapplicator driven syringe is used to fill the feeding corks (0576X489–5).

After a feeding period Dr. Rinderer empties feeding boards, catching the bees in storage traps. The bees, which were fed identical suspensions, will be observed and survival ratios established (0576X488–6).



Right: *In order to determine the exact pH at which the botulism organism can thrive, Mr. Huhtanen innoculates test tubes of tomato juice with spores of* Clostridium botulinum *(0676X647–20).* **Below:** *Mr. Huhtanen checks the pH of tomato juice after mold has grown. The indicated level of 5.62—the normal pH for tomato juice is approximately 4.20—is high enough to allow* Clostridium botulinum *to grow (0676X647–10).*

MENACE TO HOME CANNERS

That ordinary looking mold on your home-canned tomatoes may indicate the presence of a much more deadly problem—botulism.

Botulism bacteria growing in the presence of molds may be the explanation for those rare, but serious cases of botulism poisoning that have occurred in people who have eaten home-canned, high-acid foods such as tomatoes and other fruits.

The acid in these foods normally prevents the growth of the botulism bacteria. Botulism poisoning, which is caused by toxins produced by the bacterium *Clostridium botulinum*, is usually associated with improperly sealed home-canned foods such as green beans, beets, and corn which are low in acid. These products must be pressure cooked at high temperatures to destroy these bacteria.

Microbiologist Charles N. Huhtanen at the Eastern Regional Research Center (600 East Mermaid Lane, Philadelphia, PA 19118) found that molds growing on the surface of home-canned high acid foods, such as tomatoes, can reduce the acidity to the point where *C. botulinum* can grow and produce toxin. Scraping off the mold does not make the rest of the product safe to eat because the toxins produced by the bacteria can diffuse throughout the product and only a minute amount of the poison can make a person fatally ill.

To study the relationship of botulism to mold growth, Mr. Huhtanen inoculated test tubes of tomato juice with botulism spores. Eleven different cultures of *C. botulinum* were tested. The botulism spores did not germinate or

produce toxin during a 60-day incubation period.

However, when Mr. Huhtanen inoculated the tomato juice with mold spores, *C. botulinum* began to grow and produce toxin 4 days after mold formed a covering, or mat, across the top of the tomato juice.

The development of the botulism toxin did not appear to change the looks or odor of the tomato juice itself. Gas bubbles were visible in the samples and tended to raise the mold mat off the surface of the juice.

During his experiments, Mr. Huhtanen found that these molds have the ability to change the pH (a measure of acidity) of the tomato juice fairly rapidly. A pH of 4.8 or below is considered too acid for the growth of botulism bacteria. Three days after a mold mat formed on tomato juice with an initial pH of 4.2, the pH under the mat was raised to 5.8.

When the initial pH was 4.6 under the mat, the mold changed it to 6.4. The acidity was lowest, and therefore most conducive to the development of botulism toxin directly under the mold mat. The acidity was greater with increasing depth of the tomato juice, however. Eventually the acidity was reduced even at the bottom to a point where *C. botulinum* would grow.

Molds are most likely to grow on improperly processed acid products when jar lids are not sealed properly. Molds require oxygen to grow. Homemakers should never eat, or even taste, canned products which show any evidence of spoilage, cloudiness, odor, gas bubbles, or that come from containers which are not properly sealed or show signs of damage—whether or not there is mold growing on them. The entire contents of such containers should be disposed of, and the containers themselves destroyed.

While botulism poisoning is relatively rare (19 U.S. cases last year including 2 deaths) it is also entirely preventable with proper canning procedures.—*M. E. N.*

Above: *Mr. Huhtanen compares a jar of tomato juice containing mold in which botulism has developed with a control jar, containing no mold, in which the botulism spores were unable to germinate and grow. Botulism spores were introduced into both jars (0676X646–7A).* **Below:** *Gas bubbles on the surface indicate the presence of botulism (0676X646–12A).*

Overall view of the mechanical exerciser that forces cows to walk a certain distance at a controlled pace (0774X1180–29A).

Bossy needs exercise too

DAIRY CATTLE today suffer from a malady common to people in modern society—they are physically out of shape. To firm up flabby muscles and strengthen weak hearts, ARS researchers have induced some cows to do what many people in similar circumstances have done, take up jogging.

With the rapid conversion to drylot confinement, dairy cows are indeed living a less strenuous life. All they are required to do is lie down, get up, eat, drink, be milked, and give birth to a calf once a year. The result of all this less-than-taxing exertion is a deterioration of the cow's health, performance, and longevity.

ARS dairy scientist Robert C. Lamb, Utah State University (U.M.C. 46, Animal Industry Bldg., Logan, UT 84322) has designed a mechanical exerciser for cows that forces the animal to walk a certain distance at a controlled pace. The health and performance of animals who undergo the exercise regime are then compared to animals whose soft life has not been disturbed.

The mechanical exerciser consists of a fenced ring around which animals are forced to walk by four moving tailgates. The tailgates are powered by a variable-speed motor and are on hinges so that if for some reason a cow resists being pushed along by a tailgate, the gate will pass harmlessly over the reluctant animal's back.

In one trial using 42 two-year-old heifers, one-third of the animals received no exercise; one-third were exercised 1 mile a day at a slow walk until calving; and the final third received the same exercise but continued their regime for 10 days after calving. Exercises took place for 4 to 8 weeks before calving.

Results showed that exercised animals gave birth easier and released the placenta quicker than did nonexercised cows. Heifers exercised only until they calved produced as much milk as nonexercised heifers; however, the exercised heifers did so on less feed. Exercising heifers after calving lowered milk production. The exerciser has also healed sore hooves, straightened humped backs, and melted excess fat.

ARS veterinarian John D. Olsen, also at Logan, has devised a standardized physical fitness test (PFT) that diagnoses the heart and circulatory condition of an individual cow, and works in conjunction with the mechanical exerciser.

Dr. Olsen first takes an electrocardiogram of the cow standing still, when she is first put in the exerciser. This provides a base measurement of the cow's heart rate. The cow is exercised for one-half mile at 4.0 miles per hour, which is a near run for a cow.

Another electrocardiogram is taken immediately at the end of exercise and the heart is monitored until the beat returns to normal.

The cow is run a second time at the same speed and distance and the heart is remonitored. Each cow undergoes the PFT for 2 consecutive days. Following the determination of the cow's physical condition she is put on an exercise program for 4 to 6 weeks.

An upcoming study will attempt to determine the best combination of speed and distance at which to exercise the cows, and will involve 80 animals.

The exerciser is designed for research and not for commercial dairymen. However, should exercise prove sufficiently important to a cow's well being, various methods to convert the program to large-scale commercial use will be tried.—*L. C. Y.*

PPV and reproductive failure

A BRED GILT is in apparently normal health during gestation, but at farrowing time her litter is abnormally small, pigs are weak, or are born dead or perhaps mummified or macerated. Or she may have aborted for no readily identifiable reason.

One cause—probably a major cause—of reproductive failures in swine is porcine parvovirus (PPV) infection, ARS veterinary medical officer William L. Mengeling points out. Other viruses associated with porcine reproductive failure are enteroviruses, pseudorabies virus, Japanese B encephalitis virus, hog cholera virus, and swine influenza virus.

PPV was isolated from mummified and stillborn pigs in the late 1960's by European scientists; however, their attempts to establish a relationship between the virus and these losses were inconclusive. The virus was first isolated from swine in the United States in 1971 and is widely disseminated in this country.

Dr. Mengeling found evidence of inapparent PPV infection in 51 percent of a group of butcher hogs he surveyed. Most pigs probably are exposed to PPV during or after birth, although subclinical infection before birth occasionally occurs—in 3 of 82 litters in 1 experiment.

Studies by Dr. Mengeling and veterinary medical officer Randall C. Cutlip at the National Animal Disease Center (P.O. Box 70, Ames, IA 50010) have now furnished evidence that directly links PPV with reproductive failures in swine.

The first study involved a farm-produced gilt from which four mummified and one normal-appearing fetus were taken by hysterectomy after she had farrowed two mummified pigs. Dr. Mengeling and associates demonstrated large amounts of PPV antigen in tissues of all six mummified fetuses, as well as antibodies for PPV in blood serum of the normal-appearing fetus. In addition, the gilt had no hemagglutination-inhibition antibodies in serum 67 days before farrowing but large amounts at farrowing, indicating that PPV infection occurred in the interim.

Dr. Mengeling and Dr. Cutlip then studied, under laboratory conditions, the effect of transuterine infection occurring at different times during pregnancy. They found that when infection with PPV occurred during approximately the first half of pregnancy, fetuses were usually killed. Examination of dead fetuses indicated that the lethality of PPV is not associated with its effect on any single tissue, but rather to the cumulative effect of the virus on many tissues as well as fetal membranes.

In contrast, fetuses infected during the latter half of pregnancy often survived, probably because their immune system is more completely developed, as well as their ability to produce antibody to the virus. Despite the presence of antibody, however, virus often persisted in clinically normal fetuses. After birth, such fetuses are a potential source of virus for other pigs.

The possibility of developing a vaccine for PPV which could be administered to gilts before they enter the breeding herd is presently under investigation.—*W. W. M.*

Day for night

A RESEARCH GENETICIST has changed day to night in a new method for hand crossing peanuts for hybridization.

The conventional method is tedious and time consuming and involves emasculating the peanut flowers in the evening or at night and then pollinating the plant the next morning when fresh sources of pollen are available.

The new method devised by ARS geneticist Donald J. Banks (274 Agriculture Hall, OSU, Stillwater, OK 74074) involves using a plant growth chamber and reversing the day and night cycle. In Dr. Banks' system, emasculations and pollinations can be made between 8 and 10 o'clock in the morning, the optimum time for working with the flowerbuds.

The new procedure allows the work to be during normal working hours and makes possible up to three crossing cycles and growth generations per year.

For the convenience of their small size, Dr. Banks used Spanish peanut cultivars in developing the new method—*B. D. C.*

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Automated apple squeezer

AN AUTOMATED SYSTEM for extracting juice from apples should considerably enhance the quality of juice over that of the traditional rack-and-cloth method.

The new system, developed at the Western Regional Research Center (800 Buchanan St., Berkeley, CA 94710) and demonstrated at several apple processing plants in Oregon and Washington, also extracts up to 7 gallons more juice per ton of apples.

The first stage of the automated system is a centrifuge that removes about half of the juice. Then the macerated apples are conveyed to a vertical screw press (like that of most kitchen meat grinders) which squeezes out the remaining juice.

The older rack-and-cloth method requires much hand labor. Workers must cover wooden trays with cloth, dump chopped apples into them, wrap the cloth over the apples, and then stack up to 20 of these trays in a press. As the press exerts pressure on the trays, the juice seeps through the cloth. Labor costs for this system are three times that of the fully automated dejuicer systems.

Moreover, the rack-and-cloth system is hard to keep sanitary. Cloths must be washed frequently to prevent a buildup of apple residue. Such deposits could cause serious off-flavors and even contaminate the apple juice with bacteria.

One large apple juice processor in Washington, where the automated method was demonstrated, is now using a similar two-stage dejuicer that can process up to 50 tons of apples per hour. The processor reports yields of 175 to 180 gallons of juice per ton of apples—*D. H. S.*

Sound shells bar fungus

THE INTACT SHELL of pecans is an effective barrier to aflatoxin-producing fungi.

Cracked shells, on the other hand, permit rapid buildup of the toxins. Thus, keeping shells sound, together with good drying and storing, would minimize contamination.

ARS plant pathologist Harry W. Schroeder (P.O. Drawer ED, College Station, TX 77840) and Texas Agricultural Experiment Station scientist James B. Storey found aflatoxins produced by *Aspergillus flavus* and *A. parasiticus* in only one uncracked nut exposed to the fungi during a 28-day test. Moreover, since the nut did not belong to the group with the longest exposure, the scientists suspect it may have had a defective shell or been previously contaminated.

The fungi are known to persist in the soil, and, for the test, the researchers simulated the damp orchard floor where pecans often lie before harvest. They used enclosed boxes containing layers of soil inoculated with strains of *Aspergillus flavus* and *A. parasiticus*. Beakers of water with sponge wicks insured high humidity in the boxes. Pecans with sound and cracked shells placed on the soil and removed for examination after five periods ranging from 8 to 28 days.

Nuts with cracked shells were contaminated after only 8 days, reaching a maximum level of 1 million parts per billion after 21 days. With the exception of the one suspect nut, however, sound-shell pecans showed no contamination from the two fungi during the entire test.—*B. D. C.*

When reporting research involving pesticides, this magazine does not imply that pesticide uses discussed have been registered. Registration is necessary before recommendation. Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife—if not handled or applied properly. Use all pesticides selectively and carefully.

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